

We claim:

1. An inspection system for the detection of an anomaly in a sample comprising
- a thermal heater array comprising a plurality discrete individually controllable heat source elements capable of imparting heat to a sample
- a heat diffuser component
- 5 an infrared camera component for monitoring infrared emissions from a side of the sample and deriving a signal indicative of the temperature profile of this side of the sample,
- a sample support component for supporting a sample for inspection
- said sample support component, said heat diffuser component and said thermal heater array being configured and disposed such that, when said support component supports a sample for inspection, the sample has an observation side and an opposite heat exposure side,
- the infrared camera is disposed on the observation side for monitoring the observation side and the diffuser component and the thermal heater array are disposed on the heat exposure side for exposing the heat exposure side to thermal radiation, the heat diffuser component being disposed between the sample and the thermal heater array.

12. A method for detecting a defect in a populated circuit board, said populated circuit board having a first side and an opposite second side, at least said first side being populated with one or more *surface mounted components* ~~Surface Mounted Components~~, said method comprising
- 20 1) directing a thermal wave at the second side of said populated circuit board
- 2) recording a thermographic image of the first side of said populated circuit board
- once a surface thereof reaches a predetermined transit temperature or a predetermined transit

time period has elapsed; and

3) analysing the obtained thermographic image by comparing the so obtained thermographic image with a standard thermographic image ^{a1}

wherein

- 5 a) the thermal wave is developed by a thermal heater array comprising a plurality of discrete individually controllable heat source elements, said elements each delivering a respective individual energy intensity reflecting the respective energy parameter information therefor comprised in a first block of energy parameter information;
- 10 b) said first block of energy parameter information comprising, for each of said heat source elements, individual energy parameter information whereby the thermal heater array may be induced to provide a thermal wave giving rise to a thermographic image indicative of uniform temperature of the surface of the first side of an predetermined unpopulated circuit board; and
- 15 c) said standard thermographic image having been obtained by i) subjecting the second side of a predetermined populated circuit board to a thermal wave developed by said thermal heater array, said thermal field being applied until a surface of the first side of the predetermined populated circuit board reaches said predetermined transit temperature or said predetermined transit time period has elapsed, said elements of said thermal heater array each being set to deliver a respective individual energy intensity reflecting the energy parameter information of said first block of energy
- 20 parameter information, and ii) taking said standard thermographic image from the first side of said predetermined populated circuit board once said predetermined transit temperature is reached or said predetermined transit time period has elapsed.

2-3.
a A method for detecting a defect in a populated circuit board, said populated circuit board having a first side and a second opposite side, at least said first side being populated with one or more ~~Surface Mounted Components~~ *surface mounted components*, said method comprising

- 1) directing a thermal wave at the second side of the populated circuit board
- 2) recording a thermographic image of the first side of the populated circuit board

5 once a predetermined transit temperature is reached on this side of the populated circuit board or a predetermined transit time period has elapsed; and

3) analysing the obtained thermographic image by comparing the so obtained thermographic image with a standard thermographic image *a2* wherein the standard thermographic image has been obtained by

- 15
- a) monitoring the temperature of a surface of the first side of an predetermined unpopulated circuit board
 - b) subjecting the second side of the unpopulated circuit board to a thermal wave developed by a thermal heater array comprising a plurality of discrete individually controllable heat source elements, said elements each being initially set to deliver an individual energy intensity such that the thermal array delivers a thermal wave of predetermined contour;
 - c) adjusting the individual energy intensity of each of said elements until the thermal array delivers a thermal wave such that the surface being monitored provides a thermographic image thereof indicative of uniform temperature
 - 20 d) storing a first block of energy parameter information corresponding to the individual energy intensity of each of said heat source elements found to provide the recorded thermographic image indicative of uniform temperature

e) monitoring the temperature of the first side of a predetermined populated circuit board

f) subjecting the second side of the predetermined populated circuit board to a thermal wave developed by a thermal heater array comprising a plurality of discrete individually controllable heat source elements, said elements each being set to deliver a respective individual energy intensity reflecting the energy parameter information of said first block of energy parameter information, said thermal wave being applied until a surface site of the first side of the predetermined populated circuit board reaches said predetermined transit temperature or said predetermined transit time period has elapsed and taking a second thermographic image; and, if desired,

g) storing a block of image information corresponding to the second thermographic image, said second thermographic image being said standard thermographic image.

31. A method for detecting a defect in a populated sample having a thickness dimension substantially smaller than the length and width dimensions thereof, said populated sample having a first side and an opposite second side, at least said first side of said populated sample having one or more ^{surface mounted components} ~~Surface Mounted Components~~, said method comprising

1) directing a thermal wave at said second side of said populated sample

2) recording a thermographic image of the first side of said populated sample once a surface thereof reaches a predetermined transit temperature or a predetermined transit time period has elapsed; and

3) analysing the obtained thermographic image by comparing the so obtained
thermographic image with a standard thermographic image

wherein

- a) the thermal wave is developed by a thermal heater array comprising a plurality of discrete individually controllable heat source elements, said elements each delivering a respective individual energy intensity reflecting the respective energy parameter information therefor comprised in a first block of energy parameter information;
- b) said first block of energy parameter information comprising, for each of said heat source elements, individual energy parameter information whereby the thermal heater array may be induced to provide a thermal wave giving rise to a thermographic image indicative of uniform temperature of the surface of the first side of an unpopulated sample; and
- c) said standard thermographic image having been obtained by i) subjecting the second side of a predetermined populated sample to a thermal wave developed by said thermal heater array, said thermal field being applied until a surface of the first side of the predetermined populated sample reaches said predetermined transit temperature or said predetermined transit time period has elapsed, said elements of said thermal heater array each being set to deliver a respective individual energy intensity reflecting the energy parameter information of said first block of energy parameter information, and ii) taking said standard thermographic image from the first side of the predetermined populated sample once said predetermined temperature is reached or said predetermined transit time has elapsed.

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A method for detecting a defect in a populated sample having a thickness dimension substantially smaller than the length and width dimensions thereof, said sample having a first side and a second opposite side, at least said first side of said populated sample having one or more ~~Surface Mounted Components~~ *surface mounted components*, said method comprising

1) directing a thermal wave at the second side of said populated sample

2) recording a thermographic image of the first side of said populated sample once a predetermined transit temperature is reached on this side of the populated sample or a predetermined transit time period has elapsed; and

3) analysing the obtained thermographic image by comparing the so obtained thermographic image with a standard thermographic image,

wherein the standard thermographic image has been obtained by

a) monitoring the temperature of a surface of the first side of an predetermined unpopulated sample

b) subjecting the second side of the unpopulated sample to a thermal wave developed by a thermal heater array comprising a plurality of discrete individually controllable heat source elements, said elements each being initially set to deliver an individual energy intensity such that the thermal array delivers a thermal wave of predetermined contour;

c) adjusting the individual energy intensity of each of said elements until the thermal array delivers a thermal wave such that the surface being monitored provides a thermographic image thereof indicative of uniform temperature

d) storing a first block of energy parameter information corresponding to the individual energy intensity of each of said heat source elements found to provide the

recorded thermographic image indicative of uniform temperature

e) monitoring the temperature of the first side of a predetermined populated sample

f) subjecting the second side of the predetermined populated sample to a thermal wave developed by a thermal heater array comprising a plurality of discrete individually controllable heat source elements, said elements each being set to deliver a respective individual energy intensity reflecting the energy parameter information of said first block of energy parameter information, said thermal wave being applied until a surface site reaches a predetermined transit temperature or a predetermined transit time period has elapsed and taking a second thermographic image; and, if desired,

g) storing a block of image information corresponding to the second thermographic image, said second thermographic image being said standard thermographic image.

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A method for obtaining a standard thermographic image for use in detecting a defect in a populated circuit board, said populated circuit board having a first side and a second opposite side, at least said first side being populated with one or more ^{surface} ~~surface~~

mounted components
~~Mounted Components~~, said method comprising

a) monitoring the temperature of a surface of the first side of an predetermined unpopulated circuit board

b) subjecting the second side of the unpopulated circuit board to a thermal wave developed by a thermal heater array comprising a plurality of discrete individually controllable heat source elements, said elements each being initially set to deliver an individual energy intensity such that the thermal array delivers a thermal wave of

predetermined contour;

c) adjusting the individual energy intensity of each of said elements until the thermal array delivers a thermal wave such that the surface being monitored provides a thermographic image thereof indicative of uniform temperature

d) storing a first block of energy parameter information corresponding to the individual energy intensity of each of said heat source elements found to provide the recorded thermographic image indicative of uniform temperature

e) monitoring the temperature of the first side of a predetermined populated circuit board

f) subjecting the second side of the predetermined populated circuit board to a thermal wave developed by a thermal heater array comprising a plurality of discrete individually controllable heat source elements, said elements each being set to deliver a respective individual energy intensity reflecting the energy parameter information of said first block of energy parameter information, said thermal wave being applied until a surface site of the first side of the predetermined populated circuit board reaches said predetermined transit temperature or said predetermined transit time period has elapsed and taking a second thermographic image; and, if desired,

g) storing a block of image information corresponding to the second thermographic image, said second thermographic image being said standard thermographic image.

A method for obtaining a standard thermographic image for detecting a defect in a populated sample having a thickness dimension substantially smaller than the length

and width dimensions thereof, said sample having a first side and a second opposite

side, at least said first side of said populated sample having one or more ^{surface} ~~surface~~

^{mounted components} ~~Mounted Components~~, said method comprising

- a) monitoring the temperature of a surface of the first side of an predetermined unpopulated sample
- b) subjecting the second side of the unpopulated sample to a thermal wave developed by a thermal heater array comprising a plurality of discrete individually controllable heat source elements, said elements each being initially set to deliver an individual energy intensity such that the thermal array delivers a thermal wave of predetermined contour;
- c) adjusting the individual energy intensity of each of said elements until the thermal array delivers a thermal wave such that the surface being monitored provides a thermographic image thereof indicative of uniform temperature
- d) storing a first block of energy parameter information corresponding to the individual energy intensity of each of said heat source elements found to provide the recorded thermographic image indicative of uniform temperature
- e) monitoring the transit temperature of the first side of a predetermined populated sample
- f) subjecting the second side of the predetermined populated sample to a thermal wave developed by a thermal heater array comprising a plurality of discrete individually controllable heat source elements, said elements each being set to deliver a respective individual energy intensity reflecting the energy parameter information of said first block of energy parameter information, said thermal wave being applied

until a surface site reaches a predetermined transit temperature or a predetermined transit time period has elapsed and taking a second thermographic image; and, if desired,

g) storing a block of image information corresponding to the second thermographic image, said second thermographic image being said standard thermographic image.